Lat 39.91027 Lon -120.50281

Forest Health Protection
Pacific Southwest Region

Date: September 19, 2008
File Code: 3420

To: District Ranger, Beckwourth Ranger District, Plumas National Forest

Subject: Evaluation of stand conditions and bark beetle activity in the Lake Davis Recreation Area (FHP Report NE08-04)

At the request of Beth Stewart, Silviculturist, Beckwourth Ranger District, I visited the Lake Davis recreation area on September 3, 2008 and again on September 17, 2008. The objective of these site visits was to evaluate the current bark beetle activity, determine the potential for future bark beetle caused tree mortality and discuss treatment alternatives including the potential for FHP funding through the Western Bark Beetle Initiative. Beth Stewart and Mike Davis, Sales Administrator, accompanied me in the field on September 3 and Beth Stewart, Barbara Boaz, ecosystem planner, Janice Sangunitto, Silviculturist, Thobe Oestreich, Forestry Technician/FSR, and Judy Schaber, Recreation Staff, accompanied me on September 17. Recommendations provided by this evaluation will assist with planning future activities, including vegetation and hazard tree management within the recreation area and the development of a long-term vegetation management plan for the campgrounds.

Background

The Lake Davis recreation area is located approximately 5 miles north of the town of Portola, CA (T24N, R13E). The elevation of the site is 5800 feet and annual precipitation for the area is slightly greater than 30 inches in the south end and less than 30 inches at the north end. Most stands around the lake are a mix of ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*Pinus jeffreyi*) and lodgepole pine (*Pinus contorta*) with some scattered white fir (*Abies concolor*) and incense cedar (*Libocedrus decurrens*). The management objectives for this recreation area are to promote and maintain the presence of healthy trees, reduce the occurrence of hazard trees and limit further bark beetle caused tree mortality.

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Observations

Figure 1. Bark beetle caused mortality of ponderosa and lodgepole pine.

High stand density combined with the recent dry weather has contributed to an increase in bark beetle caused tree mortality along the southwest shore of the lake. Most of this mortality is occurring in ponderosa and lodgepole pine as a result of successful attacks by the western bark beetle (*Dendroctonus brevicomis*) and mountain pine beetle (*Dendroctonus ponderosae*) creating large pockets of dead trees (Figure 1). The stand density in this area is extremely high with SDI plot measurements ranging up to 580 (Figure 2).

Red turpentine beetle (*Dendroctonus valens*) activity was observed within the Grasshopper Flat campground on a large Jeffrey pine near a recent small group kill of young ponderosa pines that were successfully attacked by both western and mountain pine beetles.

Western dwarf mistletoe (*Arceuthobium campylopodum*) was observed in ponderosa and Jeffrey pines in the Grasshopper Flat campground and in pine stands between campgrounds. Some stands are suffering from high infection levels (average Hawksworth rating = 4) and are currently experiencing high levels of bark beetle activity.

Stand density within and adjacent to both the Grizzly and Grasshopper Flat campgrounds are above recommended levels for reducing the risk of bark beetle caused tree mortality especially when considering the potential impacts of compaction from foot and vehicle traffic on site carrying capacity (Figure 3).

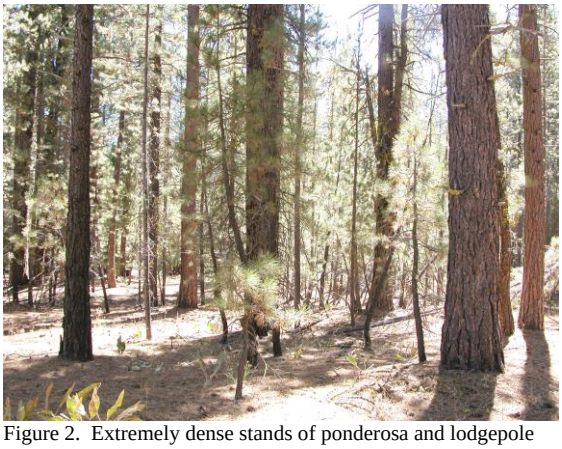

Figure 2. Extremely dense stands of ponderosa and lodgepole pine.

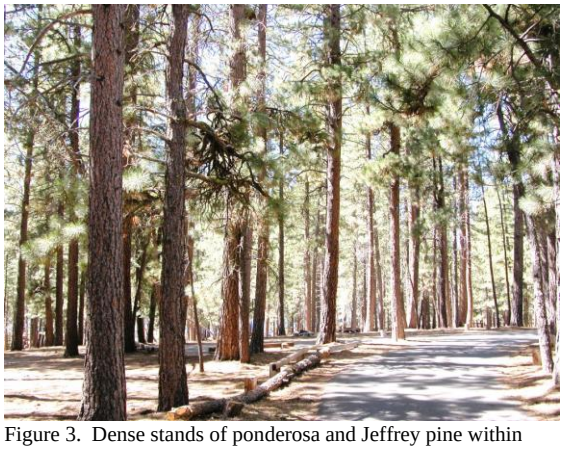

Figure 3. Dense stands of ponderosa and Jeffrey pine within the campground (note brooming of lower branches caused by western dwarf mistletoe infections).

Discussion and Recommendations

Southwest Shore (Bald Eagle area)

The dense stands in this area (current stand density in this area ranges from SDI 250 to 580 with basal area ranges from 120 to over 400) would benefit from thinning. Trees should be thinned to a basal area appropriate for the site in order to improve stand health and vigor. To reduce the susceptibility to future bark beetle related mortality, stands should be thinned to densities that are 80% or less of normal basal area, effectively reducing tree competition for limited water and nutrients. Recent direction from the Regional Forester suggests designing thinnings to "ensure that density does not exceed an upper limit (for example: 90% of normal basal area, or 60% of maximum stand density index); this is a prudent way to avoid the health risks associated with density. Design thinnings to ensure that this level will not be reached again for at least 20 years after thinning." (Regional Forester letter, "Conifer Forest Density Management for Multiple Objectives", July 14, 2004). When implementing thinning projects, selecting for more drought tolerant species such as ponderosa and Jeffrey pine over lodgepole pine and white fir will make stands more resilient to disturbance agents such as insects, disease, and fire. In addition to reducing tree stress, thinning, especially of the understory, will somewhat reduce the risks and damage from any fire that might occur and provide a more defensible space for the recreation area.

Grasshopper Flat and Grizzly Campgrounds

Trees in the Lake Davis campgrounds, similar to most forested campgrounds, are exposed to additional stress factors that can compromise their health and vigor. Firewood collecting sometimes leads to tree wounding from hatchets and saws, foot and vehicle traffic from campers can result in increased soil compaction and root damage, and the desire for screening between campsites and increased canopy cover can result in overstocking of both understory and overstory trees.

Soil compaction in campgrounds can predispose pines to bark beetle attacks. Compaction can reduce the water holding capacity of the soil. Compacted soils also tend to suffocate roots, limiting the available oxygen that is necessary for root growth and survival. Damaged and unhealthy roots cannot provide the upper portions of the tree with the water and nutrients it requires to maintain its natural defenses. Root damage is a long-term problem that may not reveal itself until several years after the damage has occurred. In order to minimize future soil compaction and root damage, campers should be confined to specific travel corridors from campsites to restrooms, water sources, and specific recreation areas. It is especially important to divert and limit foot and vehicle travel and restrict excavation for roads, trails and utilities as much as possible from the root zones of trees.

High stand density in both campgrounds is also playing a role in predisposing trees to bark beetle attacks. Excessive competition for limited water and nutrients puts stress on individual trees and reduces their ability to maintain an adequate defense system. Overstocked stand conditions may persist over time with limited bark beetle caused mortality until triggered by drought or other factors. Bark beetle caused mortality within a campground can result in a dramatic reduction in

stocking, especially in the larger size classes, and an increase in the number of hazard trees that must be removed.

To increase health and vigor and reduce the risk of future bark beetle caused tree mortality, stands in both campgrounds should be thinned to a basal area appropriate for the site. When determining the carrying capacity of the site the effects of soil compaction should be considered as site quality may be reduced. In addition, where compaction exists, trees may not respond as expected after thinning treatments. In general, to reduce the susceptibility to future bark beetle caused tree mortality, stands should be thinned to densities that are 80% or less of "normal", effectively reducing tree competition for limited water and nutrients.

When planning thinning treatments, it should be recognized that the target stocking level is an average to be applied across the landscape and some variability may be desired. Individual high value trees, such as mature pine, as well as pure stands of younger ponderosa and Jeffrey pine should benefit by having the stocking around them reduced to lower levels. In addition, thinning can decrease the need to enter stands to conduct salvage operations, decrease the amount of fuel loading and reduce the number of hazard trees.

For trees with branch swelling and brooms caused by dwarf mistletoe, depending on the degree of symptoms, consideration should be given to tree removal or at a minimum selective pruning within the crown to remove the dead or diseased limbs that could snap off and strike campers. Removing infected limbs will also reduce the number of seeds that can disperse and infect susceptible understory trees. Depending on the level of dwarf mistletoe infection, removal of infected limbs can improve the health and vigor of the tree as long as at least 50% of the original live crown remains after treatment.

White fir growing in this area are at an elevated risk to bark beetle attacks due to the low annual precipitation. The long-term average annual precipitation of approximately 30" for this site is right at the threshold for what is generally required to sustain white fir over a generation (the lower limit of precipitation in the natural range of white fir is about 20 inches). Therefore, even with lower stocking levels, white fir growing on this site is at a higher risk for fir engraver beetle caused mortality. High stand density combined with the last prolonged drought (1987-1992) resulted in elevated levels of white fir mortality throughout northeastern California as documented in previous FHP evaluations (Schultz 1994) and aerial surveys. During this time, the areas with the highest white fir mortality were those with less than 30" annual precipitation.

It is important to note that when implementing tree removal or hand thinning in a recreational site it is Region 5 policy (FSM R5 Supplement 2300-92-1) to treat all conifer stumps with a registered borate compound to reduce the probability of infection by *H. annosum.* Care also needs to be taken to minimize both wounding of residuals and site disturbance.

General Recommendations for Campgrounds

Maintaining and promoting healthy trees are important objectives for development plans in campgrounds. Care should be taken during future campsite, trail and facility construction to

minimize negative impacts on the landscape. The following guidelines should be applied for areas under construction or in areas where future construction will take place.

- Tree density should be appropriate for the site. This will provide access to light, moisture and nutrients and allow the trees to better cope with their altered environment.
- Trees that will directly interfere with structures or that will be seriously damaged during construction or excavation should be removed.
- Leave a mixture of ages and species to provide a continual forest canopy over the years.
- Fence off individual or groups of trees before construction to negate or minimize root damage by soil compaction or trunk and root damage by equipment. Protective fences should be placed, at a minimum, at drip line. Depending on the species, tree roots can exist within a radius two times the crown radius and encompass an area well beyond drip line. Drip line is defined by the outer edge of the foliage. Penalties for damaging trees should be incorporated into tree removal or construction contracts.
- Road or lot grades should be changed as little as possible. Grading damages roots and can set up conditions that favor soil erosion. It can also alter the contour such that the flow of surface and subsurface water is drastically affected.
- Trenches should always be dug away from tree roots.
- Do not back fill with earth or rocks around the trunks of trees.
- Avoid paving with either concrete or asphalt over root systems, or close to the trunks of trees.
- Use caution in applying wood preservatives and other chemicals to buildings. Trees and other plants have been killed by direct contact with them or as a result of their runoff in rainwater.
- Avoid leaving green pine slash on site to prevent the build up of pine engraver (*Ips pini*) beetle populations that may attack standing green trees.

Future construction or vegetation management activities that incorporate the above guidelines will help assure the existence of vigorous and healthy trees following project completion.

Despite the effectiveness of any long or short-term plans to prevent tree injury and mortality, some trees, through declining health, will eventually become hazards to the public. To minimize the risks associated with hazard trees, they should be identified and removed before they fail. The current practice for many National Forest campgrounds is to remove trees as they die. This eliminates the risk from dead trees but fails to address living trees that are infected with root disease, heart rot, and/or have a structural defect. These high-risk green trees are equally hazardous and should not be overlooked. Therefore, it is recommended that the Forest develop a hazard tree evaluation and monitoring plan for its campgrounds. At your request, Forest Health Protection can provided information and assist with the development of this plan. In the short-term, trees within the campground that have obvious stem decay, dead tops and/or large dead branches should be carefully evaluated and hazards removed or pruned as soon as possible. All standing dead trees within striking distance of campsites or campground facilities should be removed immediately.

Forest Health Protection Funding

FY09 Forest Health Protection funding is being requested by the District through the Western Bark Beetle Initiative to thin overstocked stands in the Lake Davis area. The FHP site visit and this is evaluation supports this proposed Lake Davis Thinning Project.

If you have any questions regarding this report and/or need additional information please contact me at 530-252-6431 or dcluck@fs.fed.us.

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Insect and Disease Information

Western pine beetle

The western pine beetle, *Dendroctonus brevicomis*, has been intensively studied and has proven to be an important factor in the ecology and management of ponderosa pine throughout the range of this host species (Miller and Keen 1960). This insect breeds in the main bole of living ponderosa pine larger than about 8 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire. Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year.

Evidence of Attack

Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pitch tubes are formed on the tree trunk around the entry holes. The pitch tubes are red-brown masses of resin and boring dust. Relatively few, widely scattered, white pitch tubes usually indicate that the attacks were not successful and that the tree should survive. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over into nearby apparently healthy trees and overwhelm them by sheer numbers.

Life Stages and Development

These beetles pass through the egg, larval, pupal and adult stages during a life-cycle that varies in length dependent primarily upon temperature. Adults bore a sinuous gallery pattern in the phloem and the female lays eggs in niches along the sides of the gallery. The larvae are small white grubs that first feed in the phloem and then mine into the middle bark where they complete most of their development. Bluestain fungi, introduced during successful attacks, contribute to the rapid tree mortality associated with bark beetle attacks.

Conditions Affecting Outbreaks

Outbreaks of western pine beetle have been observed, and surveys made, in pine regions of the West since 1899 (Hopkins 1899; cited in Miller and Keen 1960). An insect survey completed in 1917 in northern California indicated that over 25 million board feet of pine timber had been killed by bark beetles. Information from surveys initiated in the 1930s indicates that there were enormous losses attributed to western pine beetle around that time. During the 1930's outbreak, most of the mortality occurred in stands of mature or overmature trees of poor vigor (Miller and Keen 1960). Group kills do not typically continue to increase in size through successive beetle generations as is typical with Jeffrey pine beetle. Rather, observations indicate that emerging beetles tend to leave the group kill area to initiate new attacks elsewhere.

The availability of suitable host material is a key condition influencing western pine beetle outbreaks. In northeastern California, drought stress may be the key condition influencing outbreaks. When healthy trees undergo a sudden and severe moisture stress populations of western pine beetle are likely to increase. Healthy trees ordinarily produce abundant amounts of resin, which pitch out attacking beetles, but when deprived of moisture, stressed trees cannot produce sufficient resin flow to resist attack. Any condition that results in excessive demand for moisture, such as tree crowding, competing vegetation or protracted drought periods; or any condition that reduces that ability of the roots to supply water to the tree, such as mechanical damage, root disease, or soil compaction, can cause moisture stress and increase susceptibility to attack by the western pine beetle. Woodpeckers and predaceous beetles are natural control agents when beetle populations are low.

Mountain pine beetle

The mountain pine beetle, *Dendroctonus ponderosae,* attacks the bole of ponderosa, lodgepole, sugar and western white pines larger than about 8 inches dbh. Extensive infestations have occurred in mature lodgepole pine forests. Group killing often occurs in mature forests and young overstocked stands of ponderosa, sugar and western white pines.

Evidence of Attack

The first sign of beetle-caused mortality is generally discolored foliage. The mountain pine beetle begins attacking most pine species on the lower 15 feet of the bole. Examination of infested trees usually reveals the presence of pitch tubes. Pitch tubes on successfully infested trees are pink to dark red masses of resin mixed with boring dust. Creamy, white pitch tubes indicate that the tree was able to "pitch out" the beetle and the attack was not successful. In addition to pitch tubes, successfully infested trees will have dry boring dust in the bark crevices and around the base of the tree. Attacking beetles carry the spores of blue-staining fungi which develop and spread throughout the sapwood interrupting the flow of water to the crown. The fungi also reduces the flow of pitch in the tree, thus aiding the beetles in overcoming the tree. The combined action of both beetles and fungi causes the needles to discolor and the tree to die.

Life Stages and Development

The beetle develops through four stages: egg, larva, pupa and adult. The life cycle of the mountain pine beetle varies considerably over its range. One generation per year is typical, with attacks occurring from late June through August. Two generations per year may develop in low elevation sugar pine. Females making their first attacks release aggregating pheromones. These pheromones attract males and other females until a mass attack overcomes the tree. The adults bore long, vertical, egg galleries and lay eggs in niches along the sides of the gallery. The larvae feed in mines perpendicular to the main gallery and construct small pupal cells at the end of these mines where they pupate and transform into adults.

Conditions Affecting Outbreaks

The food supply regulates populations of the beetle. In lodgepole pine, it appears that the beetles select larger trees with thick phloem, however the relationship between beetle populations and phloem thickness in other hosts has not been established. A copious pitch flow from the pines can prevent successful attack. The number of beetles, the characteristics of the tree, and the weather affect the tree's ability to produce enough resin to resist attack. Other factors affecting the abundance of the mountain pine beetle include nematodes, woodpeckers, and predaceous and parasitic insects. As stand susceptibility to the beetle increases because of age, overstocking, diseases or drought, the effectiveness of natural control decreases and pine mortality increases.

Red Turpentine Beetle

The red turpentine beetle, Dendroctonus valens, occurs throughout California and can breed in all species of pines. It normally attacks injured, weakened or dying trees and freshly cut stumps. The adults are attracted by fresh pine resin. They often attack wounded trees in campgrounds or following logging, trees scorched by wildfire or prescribed burns, lightning-struck trees and root-diseased trees exhibiting resinosis.

Attacks usually occur at the soil line or root crown and are characterized by a large reddish pitch tube at the point of entry. On severely stressed trees or during periods of drought, attacks may occur underground

on the main roots up to 15 feet from the bole and also on the bole to a height of 10 feet. If an attack is successful, the adults excavate an irregular gallery in the cambium and the female lays eggs along the sides. The larvae feed in a mass and destroy an area of cambium ranging from 0.1 to 1.0 square feet. Attacks do not always kill trees but may predispose them to attack by other bark beetles. Repeated or extensive attacks by the red turpentine beetle can kill pines.

Attacks occur throughout warm weather and peak at mid-summer. The number of generations varies from two years for a single generation at the coldest portions of its range to two or three per year in the warmest.

Attacks can be minimized or prevented by avoiding soil compaction and injury to standing trees during logging or construction and also by insecticide application to high value trees.

Dwarf Mistletoe

Dwarf mistletoes (Arceuthobium spp.) are parasitic, flowering plants that can only survive on living conifers in the Pinaceae. They obtain most of their nutrients and all of their water and minerals from their hosts.

Dwarf mistletoes spread by means of seed. In the fall the fruit ripen and fall from the aerial shoots. The seeds are forcibly discharged. The seed is covered with a sticky substance and adheres to whatever it contacts. When a seed lands in a host tree crown, it usually sticks to a needle or twig, where it remains throughout the winter. The following spring the seed germinates and penetrates the twig at the base of the needle. For the next 2-4 years, the parasite grows within the host tissues, developing a root-like system within the inner bark and outer sapwood, and causing the twig or branch to swell. Aerial shoots then develop and bear seed in another 2-4 years.

Dispersal of dwarf mistletoe seeds is limited to the distance the seeds travel after being discharged. From overstory to understory, this is usually 20 to 60 feet, but wind may carry them as far as 100 feet from the source. A rule of thumb is that the seeds can travel a horizontal distance equal to the height of the highest plant in an infected tree. There is some evidence that long distance spread of dwarf mistletoe is occassionaly vectored by birds and animals.

Vertical spread within tree crowns of most dwarf mistletoes is limited to less than one foot per year because of foliage density. Because of the thin crowns of gray pine, however, the vertical rate of spread has been measured as being greater than 2 feet per year. This rate of spread equalled or exceeded the rate of height growth of infected trees.

Dwarf mistletoes are easy to identify because they are generally exposed to view within a tree's crown. Signs of infection include the yellow-green to orange mistletoe plants, basal cups on a branch or stem where the plants were attached, and detached plants on the ground beneath an infected tree. Symptoms include spindle-shaped branch swellings, witches' brooms in the lower crown, and bole swellings.